CHAPTER I

INTRODUCTION

1.1 Background

Many students face difficulty in learning science, especially natural science. A study by Tekkaya, Özkan, & Sungur (2001) stated that the main reasons on why student found learning science is difficult, because science includes a lot of concepts, various biological events that cannot be seen by the naked eye, some concepts are too abstract, and that there are a lot of scientific terms. Moreover, as a discipline, natural science encompasses a great deal of topics, concepts and issues that students have to learn. This condition is related to statement from Liu & Hmelo- Silver (2009) that learning science requires students to develop systematic and integrated understanding of complex phenomena despite of the technical terms and concepts. This means, to fully comprehend science topic, students need to grasp complex information by relating one concept to another concept, and not to mention that they also have to memorize the scientific terms, and thus gives excess load to students' thinking process.

To help students facing their difficulty, there should be a strategy from teachers that can facilitate students to construct their knowledge and master every attributes of a concept and connected them for attaining the final concept. The recent findings argue that learning is facilitated when information is available in more than one format (Okeefe, Letourneau, Homer, Schwartz, & Plass, 2014).

Based on that argument the innovation in teaching is to use multiple representation for explaining a concept. Multiple representation is defined as using at least two representation to explain about one topic. It is already known that in one topic of science learning, students have to comprehend every concept and make a red line between each concept. While Ainsworth (1999) stated there is rarely, if ever, a single representation that is effective for all tasks. This way the multiple representation can help learning process by complementing every representation to complete all task requirement. Ainsworth (1999) stated that multiple representation has function to help students in learning about science by

complementary roles, constrain interpretation, and construct deeper understanding. The function has potential to be implemented in classroom to help students generating information and constructing the knowledge without giving much load on the thinking process.

On the other hand, learning science is defined to be optimal not only when students are able to retrieve concepts, but also when students are able to observe natural phenomena and interpreting it into logical explanation. One must be able to communicate the explanation of natural phenomena to fully achieve the knowledge. The process from observing until communicating logical explanation is achieved by following a procedure called scientific method, giving the order as observing, hypothesizing, experimenting, analyzing, making conclusion, and communicating the explanation.

Here is when reasoning become an important part in learning science as it by Holyoak & Morrison (2005) is defined as a process of drawing conclusion from some initial information (premises) and expressing it into logical explanation, meanwhile Sharrock & Anderson (2011) defined reasoning as a flow of proposition within discourse of reasoned argumentation. The definitions make reasoning always goes hand in hand with the use of scientific method. The information is gathered by observing natural phenomena while the conclusion that is drawn from the information is translated into logical explanation and are communicated in form of arguments.

The practice of reasoning in learning science giving students reasoning skill. Reasoning skill is a skill developed by students when they are able to make a connection between each fragment of information to generalized information to be applied in novel case. To put it simple, reasoning skill in learning science means to gain knowledge from observing natural phenomena and translated it into conclusion in form of logical explanation that communicated through arguments to be applied in novel case. Ariës, Groot, & Van Den Brink (2015) stated that reasoning abilities are improved when more information is being stored and manipulated in working memory. This is also in line with the complementary

roles in the function of multiple representation that is used for reducing the load of students when they are required to comprehend many information at once.

From the explanation above, this study focus on using multiple representation method on students' reasoning skill. The topic of science that raised in this study is respiratory system topic. This topic is chosen because to comprehend this topic, students must define all the parts of the respiratory organs, relate the structure of organs to its function, and describe the concept that applied in the respiratory system. Those tasks cover many information and require them to make a red line between each information. Thus this topic is considered to be able to develop students' reasoning skill if it is being taught in multiple representation.

1.2 Research Problem

Based on the background stated, the research problem of this study is "How is the effect of multiple representation method on students' reasoning skill in learning respiratory system?"

1.3 Research Questions

Elaborating the research problem, the research attempts to explore the following questions:

1. How is the effect of multiple representation method on students' reasoning skill in learning respiratory system?
2. How is the effect of multiple representation method on students' argumentation level in learning respiratory system?
3. How is the effect of multiple representation method on students' quality of argument in learning respiratory system?

1.4 Limitation of Problem

There are several terms that used in this study. To avoid misinformation of terms used, the terms stated are limited as follow:

1) Multiple representation in this study is limited to definition from Ainsworth (1999) as an environment where the knowledge is presented using more than one representation. This study apply multiple representation method by arranging learning activity that give the information in one representation and asking the students to translate the information into another representation. The representations were in form of picture, descriptive text, graph, and hands-on representation.
2) Reasoning skill in this study is limited to the definition given by Holyoak & Morrison (2005) as a process of drawing conclusions from some initial information (premise) and as a flow of proposition within discourse of reasoned argumentation (Sharrock & Anderson, 2011). In which the reasoning skill is measured by the written arguments from students in answering question related to respiratory system. The arguments is analyzed using scheme from Toulmin that was modified by (Dawson & Venville, 2009), categorizes argument into four levels based on the elements of *claim, warrant, data*, *qualifier,* and *backing.*
3) Respiratory system topic in this study is limited based on the learning indicator from Cambridge curriculum with subtopics of human respiratory organ, mechanism of breathing, and aerobic respiration.

1.5 Research Objective

The objective of this research are defined as:

1) Investigate the effect of using multiple representation method on students' reasoning skill.
2) Investigate the effectiveness of using multiple representation method on students' argumentation level.
3) Investigate the effectiveness of using multiple representation method on students' quality of argument.

1.6 Significance of Research

The significance of this study is expected to cover the aspects below:

1) For Teacher, this study may help to define criterion for effective way in using multiple representation for teaching science.
2) For students, along with this research, they can experience interesting and effective method in learning. They also expected to gain concept comprehension and develop reasoning skills.
3) For researchers, this study proposed as reference of for improving teaching and learning process in science using multiple representation.

1.7 Organization Structure of Research

This section explains the sequence of details for each chapter in this study. This study consists of five chapters; Introduction, Literature Review, Research Methodology, Result and Discussion, and Conclusion, Implication and Recommendation. In Chapter I about Introduction, it describes the background of this study, stated in the research problem and derived into research question. This chapter also consists of the objective of research, significance of research, limitation of problem and the organization structure of the research. Whereas the Chapter II consist of theories that support the problem of this study. It describes of the theory about multiple representation method, reasoning skill, respiratory system topic, and relevant research about multiple representation and reasoning skill.

The process of how this study was done is explained in detail in Chapter III Research Methodology. This chapter consists of research method, research model, population and sample, operational definition, research instrument, research procedure, and research plot. The data gained from the process were interpreted and explained in Chapter IV Result and Discussion. In detail, this chapter presents the result of the research including the implementation of multiple representation, students' reasoning skill based on pre- and post-test, student's argumentation

level, and students' quality of argument. It also explains the implication of the result data and effect of multiple representation to students' reasoning skill.

The last chapter is Chapter V Conclusion, Implication, and Recommendation. This chapter presents the conclusion and the implication from this study and recommendation for further research with the similar topic with this research.